NEW FORM OF CARBON

Examiner: Yuan S.N. 08/471,890 Art Unit: 1795 June 20, 2010

Response to Amendment

1. This Office action is responsive to the amendment filed on March 12, 2009. Claims 89-121 are cancelled by the amendment. The March 12, 2009 amendment newly presents claims 122-163. It is noted that applicants filed a supplemental amendment on September 25, 2009. The supplemental amendment was neither requested by nor expected by Examiner Yuan. For the reasons articulated below, the supplemental amendment will not be entered into the record.

Applicants make the following statements on the first two pages of the remarks of the supplemental reply filed on September 25, 2009:

> Claims 122-163 were pending in this application after the amendment filed March 12, 2009. Claims 164-245 are newly presented. Of those, claims 164-201 are duplicates of the claims suggested by Examiner Yuan in his proposed Examiner's Amendment, and are therefore allowable. Claims 202-245 are newly presented and responsive to the interviews with Examiners Chaney, Tsang-Foster, Hendrickson and Examiner Yuan. The Applicants would like to reiterate their thanks to all the Examiners involved for their help in moving prosecution of this application forward. Applicants believe that the language presented in these additional claims addresses several of the issues raised by each Examiner in the recent Examiner interviews, and in any event places the application in better condition for appeal.
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> The Office did not require that Applicants submit an interview summary for the interview with Examiners Chaney and Tsang-Foster on September 23, 2008. An interview summary of the interview with Examiner Hendrickson was submitted on March 19, 2009. Since then, the application has been assigned to Examiner Yuan, and Applicants have participated in several interviews with Examiner Yuan in the interim, culminating in the interview of yesterday, September 24, 2009. Essentially, Examiner Yuan has offered allowability of claims which recite solubility in non-polar organic solvents. Applicants believe that all the claims pending and newly submitted above are allowable given the pioneering nature of the invention. Favorable consideration of all the claims is respectfully requested.

> New claims 164-201 find support in the pending claims and have been accepted by the Examiner. Applicants have detailed in the table below where support can be found in the application for the claims 202-245. No prohibited new matter has been added. At the outset, Applicants note that Examiner Yuan had expressed concern that some of the newly proposed claim terms, i.e., "soccer ball" and "icosahedron," were only found in the Background of the application.

These statements in the remarks of the September 25, 2009 supplemental reply do not appear to fully reflect the interviews that have taken place for this present application since September 2008. Therefore, the Examiner provides the following detailed statements to summarize the interviews since September 2008 in this present application.

On September 23, 2008, applicants' representative met with Examiners Chaney and Tsang-Foster to discuss the claims of the instant application, 08/471,890 (hereinafter referred to as the "product application"), and the claims of copending application 08/486,669 (hereinafter referred to as the "process application"). For the instant product application, an agreement was reached in the September 23, 2008 interview that an Examiner's amendment would be made canceling the pending claims and adding a new set of claims mirroring those allowed in corresponding parent application 07/580,246, now U.S. Patent No. 7,494,638, but limited to the genus of "cage molecules consisting of carbon atoms soluble in non-polar organic solvents."

Similarly, for the copending process application, an agreement was reached in the September 23, 2008 interview that an Examiner's amendment would be made canceling the pending claims and adding a new set of claims mirroring those allowed in parent application 08/236,933, now U.S. Patent No. 7,473,410, but limited to the genus of "cage molecules consisting of carbon atoms soluble in non-polar organic solvents."

Shortly after the September 23, 2008 interview, Examiner Chaney determined that, due to the long prosecution histories of both the instant product application and the copending process application and the change in claim amendment practice as set forth in 37 CFR 1.121, claim amendments by applicants rather than by the examiner would be clearer for the record and would prevent possible publication errors. Unlike current amendment practice which requires applicants to submit all pending claims, including amendments to the claims, in the same paper, previous amendment practice permitted an applicant to submit only claims that were currently being amended. Thus, the pending claims in both applications at the time of the September 23, 2008 interview spanned over multiple, separate amendment papers in their respective files, Applicants' representative, Thomas Meyers, agreed that instead of amending the pending claims in both applications by Examiner's amendment, it would be best for applicants to submit the claim amendments agreed upon in the September 23, 2008 interview to place the product application and the process application in condition for allowance. Examiner Chaney expected applicants to file the agreed upon amendments discussed during the September 23, 2008 interview in response to the non-final Office actions in each of the two applications.

On March 12, 2009, applicants filed an amendment in the present product application cancelling claims 89-121 and adding new claims 122-163 that did not include the agreed upon language in all of the independent claims. Specifically, the claims were not limited to the genus of "cage molecules consisting of carbon atoms soluble in non-polar organic solvents." Instead, the claims were more broadly directed to "cage molecules consisting of carbon atoms."

The product application was assigned to Examiner Hendrickson during Examiner Chaney's extended leave of absence. On March 19, 2009, applicants had a telephonic interview with Examiner Hendrickson on the instant product application. As stated in applicants' interview summary dated March 19, 2009, Examiner Hendrickson "indicated that he would soon issue a rejection under § 112 in a new Office Action on the ground that the term 'cage' other than 60 carbon atoms or 70 carbon atoms are not enabled by the application as originally filed" and "agreed that if Applicants amend the claims to limit the term 'cage' to consist of '60 carbon atoms' or '70 carbon atoms' throughout the pending claims, such amendment would overcome such rejection under § 112 and as a result, all claims would be allowable."

The product and process applications were thereafter assigned to Examiner Yuan. On September 11, 2009, in an interview with Mr. Jason Barron, Examiner Yuan proposed examiner's amendments (see attachments to the interview summary included herein) for both the product and process applications. The proposed examiner's amendments incorporated into all of the independent claims the language "cage molecules consisting of carbon atoms that are soluble in non-polar organic solvents" that was agreed upon in the interview dated September 23, 2008. **As noted above, the amendment filed on March 12, 2009 in the present product application did not include this agreed upon language in all of the independent claims**. Instead, the claims were more broadly directed to "cage molecules consisting of carbon atoms." This is true even though Applicants' representative indicated at one point during the interviews in September

2009 that applicants would likely accept the September 11, 2009 proposed examiner's amendment for the process application.

Two more interviews were held with Examiner Yuan on September 23 and 24, 2009. On September 23, 2009, Mr. Barron faxed a draft amendment for the present product application (see attached interview summary included herein) that adopted the examiner's proposed amendment for claims 122-163 and added new claims 164-181. On September 24, 2009, Examiner Yuan quickly reviewed proposed independent claim 164 drawn to "A substantially pure fullerene compound comprising a polyhedral carbon cage." Examiner Yuan told Mr. Barron on September 24, 2009 that proposed claim 164 was not supported by the original disclosure because the present day meaning of fullerene encompasses carbon nanotubes which applicants did not invent, and therefore applicants' proposed amendment for the product application would not be accepted. It is also noted that the term fullerene was not used in the original disclosure of the present product application. Furthermore, the term "fullerene compound" in claim 164 was never discussed in any interview prior to September 2009 nor addressed in any of the previous Office actions of record. Examiner Yuan asked Mr. Barron again on September 24, 2009 if applicants would be willing to accept the September 11, 2009 proposed examiner's amendments for the present product application and copending process application, and requested a definite answer by the next business day. In response to Examiner Yuan's inquiry about the proposed examiner's amendments for the product and process applications, applicants filed supplemental amendments on September 25, 2009 in both applications. By not accepting the proposed examiner's amendments, it appears that applicants

consider the limitations "cage molecules consisting of carbon atoms that are soluble in non-polar organic solvents" and "cage molecules consisting of carbon atoms" to be different in scope and not synonymous.

According to applicants' statement on the first page of the remarks in the September 25, 2009 supplemental reply of the present product application, new claims 164-201 are duplicates of the claims suggested by Examiner Yuan in his proposed examiner's amendment, while new claims 202-245 are responsive to the interviews with Examiners Chaney, Tsang-Foster, Yuan, and Hendrickson. However, it is the Examiner's position that new claims 202-245 are not responsive to any interview held in connection with the present product application in that they do not adopt any suggestions made by the examiners during those interviews that would place the application into condition for allowance. Specifically, new claims 202-218 correspond to claims 164-180 proposed by applicants on September 23, 2009 which were not accepted by Examiner Yuan for the reasons discussed above. Further, new claims 219-245 were not suggested by Examiners Chaney, Tsang-Foster, Hendrickson, and Yuan in any interview relating to the present product application.

Supplemental replies are governed by 37 CFR 1.111(a)(2).

37 CFR 1.111(a)(2) states:

> (i) A reply that is supplemental to a reply that is in compliance with § 1.111(b) will not be entered as a matter of right except as provided in paragraph (a)(2)(ii) of this section. The Office may enter a supplemental reply if the supplemental reply is clearly limited to:
>
> (A) Cancellation of a claim(s);
>
> (B) Adoption of the examiner suggestion(s);

(C) Placement of the application in condition for allowance;
(D) Reply to an Office requirement made after the first reply was filed;
(E) Correction of informalities (*e.g.*, typographical errors); or
(F) Simplification of issues for appeal.
(ii) A supplemental reply will be entered if the supplemental reply is filed within the period during which action by the Office is suspended under § 1.103(a) or (c).

The supplemental reply filed on September 25, 2009 in the present product application is not strictly limited to:

(A) Cancellation of a claim(s);
(B) Adoption of the examiner suggestion(s);
(C) Placement of the application in condition for allowance;
(D) Reply to an Office requirement made after the first reply was filed;
(E) Correction of informalities (*e.g.*, typographical errors); or
(F) Simplification of issues for appeal.

Therefore, the September 25, 2009 supplemental reply in the present product application lacks an entry right and **will not be entered** pursuant to 37 CFR 1.111(a)(2). Claims 122-163, filed on March 12, 2009, are pending and are finally rejected for the reasons set forth below.

Applicants are reminded that for amendments filed after-final, MPEP 714.13 states in pertinent part (emphasis added):

II. ENTRY NOT A MATTER OF RIGHT

It should be kept in mind that applicant cannot, as a matter of right, amend any finally rejected claims, add new claims after a final rejection (see 37 CFR 1.116) or reinstate previously canceled claims.

Except where an amendment merely cancels claims, **adopts examiner suggestions**, removes issues for appeal, or in some other way requires only a cursory review by the examiner, compliance with the requirement of a showing under 37 CFR 1.116(b)(3) is expected in all amendments after final rejection.

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> An amendment filed at any time after final rejection, but before an appeal brief is filed, may be entered upon or after filing of an appeal brief **provided the total effect of the amendment** is to (A) remove issues for appeal, and/or (B) **adopt examiner suggestions.**

Terminal Disclaimer

2. The terminal disclaimer filed on 22 February 2005 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of any patent granted on Application Serial No. 07/580,246, now U.S. Patent No. 7,494,638, has been reviewed and is accepted. The terminal disclaimer has been recorded.

Claim Objections

3. Claim 153 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form.

Claim 153, which depends from claim 152, recites the limitation "wherein step (c) comprises heating the carbon product comprising cage molecules in a vacuum or inert atmosphere at effective sublimation temperatures to extract the carbon product comprising cage molecules from said sooty carbon product." However, claim 152 recites the limitation "wherein the sublimation occurs at a temperature ranging from 100° - 500° C." The effective sublimation temperature recited in claim 153 is not limited to the temperature range recited in claim 152.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

5. Claims 122-127, 130, 131, and 133-163 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Independent claims 122-126, 130, and 131 are directed to cage molecules consisting of carbon atoms. There is no support in the original disclosure, at the time of filing of the present application, for the genus drawn to cage molecules consisting of carbon atoms. The genus to "cage molecules consisting of carbon atoms" in these later filed claims is not limited to cage molecules consisting of carbon atoms that are soluble in non-polar organic solvents. The genus "cage molecules consisting of carbon atoms" encompasses carbon nanotubes for which there is no written description support in the original disclosure. The specification only explicitly describes the production and isolation of C_{60} and C_{70}. The specification also states at page 11 that there is "evidence of the existence of a cage[d] molecule containing 240 carbon atoms or a C_{240} molecule" in a carbon sample prepared in accordance with a procedure described in the specification.

These two species, C_{60} and C_{70}, which share the physical property of being soluble in non-polar organic solvents as described in the specification, support and are representative of the

family members belonging to the genus "cage molecules consisting of carbon atoms that are soluble in non-polar organic solvents." C_{240} is also a higher order family member of this genus. See also Figures 20 and 22 in the journal article by Kroto et al. ("C_{60}: Buckminsterfullerene," Chem. Rev. 91 (1991), pp. 1213-1235), which was submitted as an attachment to Dr. Harold Kroto's declaration dated 27 August 2007 and filed on September 7, 2007 in the instant application, for other exemplary family members of this genus of "cage molecules consisting of carbon atoms that are soluble in non-polar organic solvents."

The genus "cage molecules consisting of carbon atoms that are soluble in non-polar organic solvents" does not encompass carbon nanotubes, which are insoluble in non-polar organic solvents. Liu et al. ("Noncovalent surface modification of carbon nanotubes for solubility in organic solvents," Carbon, Vol. 44 (2006), pp. 1613-1616)) and Chen et al. ("Solution Properties of Single-Walled Carbon Nanotubes," Science 282, (1998), pp. 95-98) provide evidence that carbon nanotubes are inherently insoluble in organic solvents. Since the original disclosure does not reasonably convey to one of ordinary skill in the pertinent art of the generic invention as is now claimed, at the time the present application was filed, these claims do not meet the written description requirement under the first paragraph of 35 U.S.C. 112.

Independent claims 133 and 150 and their respective dependent claims 134-149 and 151-163 are directed to the genus of cage molecules prepared by the process recited in the claims. The cage molecules are not limited to cage molecules consisting of carbon atoms that are soluble in non-polar organic solvents. There is no support in the original disclosure at the time of filing

of the present application for the genus to cage molecules. Furthermore, the genus of "cage molecules" recited in these claims is not limited to cage molecules consisting of carbon atoms that are soluble in non-polar organic solvents. The genus "cage molecules" encompasses cage molecules consisting of elements that are not carbon for which there is no written description support in the original disclosure. The genus "cage molecules" also encompasses carbon nanotubes for which there is no written description support in the original disclosure.

Claim 133 and its dependent claims differ from claim 150 in that they do not encompass carbon nanotubes since claim 133 recites "contacting the sooty carbon product with a non-polar organic solvent effective to dissolve cage molecules." Nevertheless, the "cage molecules" recited in claim 133 and its dependent claims encompass cage molecules made up of elements besides carbon that are soluble in non-polar organic solvent, and these cage molecules are not supported by the original disclosure. The specification only explicitly describes the production and isolation of C_{60} and C_{70}. The specification also states at page 11 that there is "evidence of the existence of a caged [sic] molecule containing 240 carbon atoms or a C_{240} molecule" in a carbon sample prepared in accordance with a procedure described in the specification.

The two species C_{60} and C_{70}, which share the physical property of being soluble in non-polar organic solvents as described in the specification, support and are representative of family members belonging to the genus "cage molecules consisting of carbon atoms that are soluble in non-polar organic solvents," to which C_{240}, a higher order member, also belongs. The genus "cage molecules consisting of carbon atoms that are soluble in non-polar organic solvents"

would neither encompass carbon nanotubes which are insoluble in non-polar organic solvents nor other cage molecules not consisting solely of carbon atoms. Since the original disclosure does not reasonably convey to one of ordinary skill in the pertinent art of the generic invention as is now claimed, at the time the present application was filed, these claims do not meet the written description requirement under the first paragraph of 35 U.S.C. 112.

As stated by Dr. Harold Kroto (who was awarded the Nobel Prize for his contribution to the discovery of C_{60}) in his supplemental declaration dated 16 November 1999 in paragraph 29 and filed on February 22, 2005 in this instant product application, the term "'caged [sic] carbon molecules consisting solely of carbon atoms which are soluble in non-polar organic solvents' uniquely describes fullerenes." It is noted that the term fullerene was not used in the original disclosure of the present application. It is also noted that the definition of fullerene at the time of the effective filing date of the present application (see for example, the attached definition of fullerene from the Concise Encyclopedia of Science and Technology, 3rd ed., Sybil P. Parker, ed., McGraw Hill, p. 819 (1994)) did not encompass carbon nanotubes since carbon nanotubes were not discovered until 1991 (See S. Iijima, "Helical microtubules of graphitic carbon," Nature, Vol. 354, No. pp.56-58, 1991) .

The species C_{60} and C_{70} and their corresponding higher order family members such as C_{240} are representative of the genus encompassed by the term fullerene as understood at the time of the effective filing date of the present application by one of ordinary skill in the art. Today, the definition of fullerene has evolved to encompass carbon nanotubes (see the attached

definition for fullerene from Kirk-Othmer Encyclopedia of Chemical Technology, John Wiley & Sons, Inc., Vol. 12, pp. 228-258, especially page 232 (2009)). Applicants clearly did not conceive of carbon nanotubes (that is, did not have possession of carbon nanotubes) or regard carbon nanotubes as their invention as of the effective filing date or actual filing date of the present application.

Independent claim 127 is directed to a product comprising a cage moiety consisting of carbon atoms. The term "moiety" is neither defined in the specification nor in the claims. According to the McGraw-Hill Dictionary of Scientific and Technical Terms ("Moiety," Def. McGraw-Hill Dictionary of Scientific and Technical Terms, 4th ed., 1989), the term "moiety" is defined as:

> A part or portion of a molecule, generally complex, having a characteristic chemical or pharmacological property.

Based on this dictionary definition of "a part or portion of a molecule" for the term moiety, the claim limitation "a product comprising a cage moiety consisting of carbon atoms" is interpreted to mean "a product comprising a cage portion of a molecule consisting of carbon atoms." Nevertheless, this dictionary definition of the term moiety does not give clarity as to the meaning of this claim limitation. The genus "a cage portion of a molecule consisting of carbon atoms" encompasses innumerable diverse molecules having a cage portion consisting of carbon atoms.

It is unclear what applicants intend to claim by the genus drawn to cage moiety consisting of carbon atoms. Applicants give two prophetic examples of a molecule having a cage portion consisting of carbon atoms on page 15 of the specification, namely $C_{60}H_{60}$ and $C_{60}F_{60}$. In these two examples, C_{60} is the cage portion (cage moiety) consisting of carbon atoms that is part of a larger molecule. The limited number of prophetic examples (on page 15) disclosed in the specification do not support the genus "cage portion of a molecule consisting of carbon atoms" having innumerable diverse members, which includes derivatives of carbon nanotubes that applicants clearly did not conceive of or regard as their invention. Since the original disclosure does not reasonably convey to one of ordinary skill in the pertinent art of the generic invention as is now claimed, at the time the present application was filed, these claims do not meet the written description requirement under the first paragraph of 35 U.S.C. 112.

Claim 152 recites the limitation "wherein the sublimation occurs at a temperature ranging from 100°-500° C." This limitation is not supported by the original disclosure.

Finally, applicants did not point out in the amendment filed on March 12, 2009 where support is found for the newly added claims. As noted above, the claim language in the amendment filed on March 12, 2009 was not suggested by the examiner during the September 23, 2008 interview. The new claims filed on March 12, 2009 do not include the claim language that was agreed to during the interview on September 23, 2008.

6. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

7. Claims 127, and 133-163 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 133 recites the limitation "contacting the sooty carbon product with a non-polar organic solvent effective to dissolve cage molecules." It is unclear if the cage molecules in this limitation refer to the cage molecules recited earlier in the claim or to some other cage molecules.

Independent claim 133 recites the limitation "recovering from said resulting product formed when the sooty carbon product was contacted with said solvent a solid carbon product comprising cage in a macroscopic amount." It is unclear what is meant by a solid carbon product **comprising cage** in a macroscopic amount. It appears that applicants intended to recite "cage molecules" in this limitation and will be interpreted as such for the purposes of prosecution of the instant application. With this interpretation, it is unclear if the cage molecules in this limitation refer to the cage molecules recited earlier in the claim or to some other cage molecules.

Independent claim 150 recites the limitation "subliming the carbon product comprising cage molecules from the sooty carbon product." It is unclear if the cage molecules in this limitation refer to the cage molecules recited earlier in the claim or to some other cage molecules.

Independent claim 150 recites the limitation "condensing the sublimed carbon product comprising cage molecules." It is unclear if the cage molecules in this limitation refer to the cage molecules recited earlier in the claim or to some other cage molecules.

Claim 153 recites the limitation "heating the carbon product comprising cage molecules." It is unclear if the cage molecules in this limitation refer to the cage molecules recited in parent claim 150 or to some other cage molecules.

Claim 153 recites the limitation "to extract the carbon product comprising cage molecules." It is unclear if the cage molecules in this limitation refer to the cage molecules recited in parent claim 150, to the cage molecules recited earlier in the claim or to some other cage molecules.

Independent claim 127 recites the limitation "a cage moiety consisting of carbon atoms." This limitation is indefinite as it is unclear what is meant by the term "moiety." The term "moiety" is neither defined in the specification nor in the claims. According to the McGraw-Hill Dictionary of Scientific and Technical Terms ("Moiety," Def. McGraw-Hill Dictionary of Scientific and Technical Terms, 4th ed., 1989), the term "moiety" is defined as:

> A part or portion of a molecule, generally complex, having a characteristic chemical or pharmacological property.

Based on this dictionary definition of "a part or portion of a molecule" for the term moiety, the claim limitation "a product comprising a cage moiety consisting of carbon atoms" is

interpreted to mean "a product comprising a cage portion of a molecule consisting of carbon atoms." Nevertheless, this dictionary definition of the term moiety does not give clarity as to the meaning of this claim limitation. The genus "a cage portion of a molecule consisting of carbon atoms" encompasses innumerable diverse molecules having a cage portion consisting of carbon atoms.

It is unclear what applicants intend to claim by the genus drawn to cage moiety consisting of carbon atoms. Applicants give two prophetic examples of a molecule having a cage portion consisting of carbon atoms on page 15 of the specification, namely $C_{60}H_{60}$ and $C_{60}F_{60}$. In these two examples, C_{60} is the cage portion (cage moiety) consisting of carbon atoms that is part of a larger molecule. The limited number of prophetic examples (on page 15) disclosed in the specification do not support the genus "cage portion of a molecule consisting of carbon atoms" having innumerable diverse members, which could also include derivatives of carbon nanotubes that applicants clearly did not conceive of or regard as their invention. Therefore, the metes and bounds of claim 127 are unclear.

Claim 151 recites the limitation "the collecting substrate." There is insufficient antecedent basis for this limitation in the claim.

Claims depending from claims rejected under 35 USC 112, second paragraph are also rejected for the same reasons.

Claim Rejections - 35 USC § 101

8. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

9. Claims 128 and 132 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.

Claims 128 and 132 are rejected under 35 U.S.C. 101 because the invention as claimed reads on coal deposits (which can be regarded as a product or a solid) containing macroscopic amounts of C_{60} and C_{70} (two species that meet the limitation "cage molecules consisting of carbon atoms soluble in non-polar organic solvents" recited in claims 128 and 132) found in nature as evidenced by Fang et al., "Evidence for fullerene in a coal of Yunnan, Southwestern China", Mat. Res. Innovat. (1997), pp. 130-132, and Osawa et al., "Survey of Natural Fullerenes in Southwestern China", pp, 421-424 in Nanonetwork Materials, edited by S. Saito et al., 2001, American Institute of Physics.

Claims 128 and 132 do not require purified cage molecules consisting of carbon atoms that are soluble in non-polar organic solvents.

Fang et al. discloses that C_{60} and C_{70} are found in macroscopic amounts in coal specimens from China (see Table 1). Table 1 shows 17 mg of C_{60} and C_{70} collected from coal specimen K with C_{60} present at a concentration of 74% and C_{70} present at a concentration of 24%. The concentration of C_{60} and C_{70} in the coal specimen K was 2.6×10^{-4} (260 ppm). Table 1 also shows 4 mg of C_{60} and C_{70} collected from coal specimen B with C_{60} present at a concentration of 85% and C_{70} present at a concentration of 15%.

Osawa et al. also found an unusually high concentration of C_{60}/C_{70} in a coal sample from the same coal mine in China (see abstract). Osawa et al. found 30 ppm of C_{60}/C_{70} in the coal sample by HPLC analysis (p. 421). The contents of C_{60}/C_{70} are considerably lower than those reported by Fang et al., but still several orders of magnitude higher than the previously reported levels of other natural fullerenes (the genus represented by the species of C_{60} and C_{70}) (order of sub-ppm) and sufficient to indicate macroscopic amounts of C_{60}/C_{70} in the coal mine.

Furthermore, in the remarks filed by applicants on May 9, 2006 in the instant product application, applicants state on page 28 that according to paragraph 17 of the Declaration of Dr. Raouf O. Loutfy (dated July 16, 2002 and filed in parent application 07/580,246, now U.S. Patent No. 7,494,638), 0.1 milligram or 100 micrograms is a macroscopic amount of C_{60} and C_{70} that can still be seen with the naked eye.

Applicants' claims 128 and 132 as written do not exclude or distinguish from the naturally occurring C_{60} and C_{70} in the coal deposits of Yunnan, China.

Furthermore, there is no evidence in the record that establishes that applicants' C_{60} and C_{70} as disclosed in the present application differ in form, quality or properties from naturally occurring C_{60} and C_{70}.

Claim Rejections - 35 USC § 102

10. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for
patent in the United States.

11. Claim 127 is rejected under 35 U.S.C. 102(b) as anticipated by Chiang et al. (U.S. Patent No. 5,294,732).

Claim 127 is not entitled to the benefit claim to parent application, 07/580,246, now U.S. Patent No. 7,494,638, whose effective filing date is August 30, 1990, since the original disclosure in the parent application does not support claim 127 drawn to a product comprising a cage moiety consisting of carbon atoms for the reasons discussed above. Furthermore, the original disclosure of the present application, filed on June 7, 1995, does not provide written description support for claim 127 for the reasons discussed above.

Chiang et al. discloses a polysubstituted C_{60} molecule, specifically, $C_{60}(CH_3CO_2)_7(NO_2)_{3.8}(OH)_{3.2}$, where C_{60} is the carbon moiety consisting of carbon atoms (abstract and col. 7, lines 49-67). This polysubstituted molecule is a species of the claimed genus. The disclosed species anticipates claim 127 drawn to the genus.

Claim Rejections - 35 USC § 103

12. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person

having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

13. Claims 128, 129 and 132 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Kappler et al. (J. Appl. Phys. 50 (1), 1979, pp. 308-316) as evidenced by Kratschmer et al. ("Search for the UV and IR Spectra of C_{60} in Laboratory-Produced Carbon Dust," in Dusty Objects in the Universe (Netherlands, Kluwer Academic Publishers, 1990), E. Bussoletti and A.A. Vittone (eds.), pp. 89-93) and Smalley (U.S. Patent No. 5,227,038).

The courts have sanctioned the use of a 35 U.S.C. 102/103 rejection when the reference inherently, but not expressly, discloses a claim limitation. See MPEP §§ 2112- 2112.02.

Claims 128, 129 and 132 do not require purified cage molecules consisting of carbon atoms soluble in non-polar organic solvents.

Kappler et al. discloses a method of producing carbon vapor by electrically heating graphite rods at 100-110 amps under an atmosphere of 30 torr of argon (p. 308, col. 2; p. 309, col. 1; p. 310, col.1 and col. 2). The graphite rods are 3 mm in diameter and 2 cm (20 mm) long (p. 308, col. 2). Carbon particles are deposited on the Pyrex wall of the evaporation apparatus at a distance of 4 cm from the vaporization source (p. 310, col. 1). Evaporation of the carbon is carried out by alternative periods of heating (2 min) and cooling (30 minutes) of the graphite rods (p. 309).

The method of Kappler et al. inherently produces carbon particles (which is a solid or a free-flowing particulate) containing macroscopic amounts of C_{60} and C_{70} because the method of Kappler et al. is nearly identical to the method disclosed by applicants (see also declarations filed

by applicants on September 2007 in the instant application) to produce macroscopic amounts of C_{60} and C_{70}, two species which read on the genus "cage molecules consisting of carbon atoms soluble in non-polar organic solvents" recited in the claims. As disclosed by applicants in the instant specification, a pressure range of 50 torr to about 400 torr produces C_{60} and C_{70} (pages 4 and 6 of the instant specification).

While Kappler et al. discloses using 30 torr of argon instead of 50 torr of argon, Kratschmer et al. discloses that a lower argon pressure compared to helium pressure is needed to produce C_{60}. Kratschmer et al. discloses that 30 torr is the lower pressure limit for argon to produce detectable features of C_{60} in an infrared or ultraviolet spectrum of carbon smoke while 50 torr is the lower pressure limit for helium to produce detectable features of C_{60} in an infrared or ultraviolet spectrum of carbon smoke (pp. 91-92). Specifically, Kratschmer et al. discloses the following on pages 91-92:

> "As far as the appearance of the features is concerned, we observed that a kind of transition pressure of the quenching gas exists above which the features appear regularly and below which they usually do not. For He, this pressure is about 50 torr and for Ar it seems to be smaller, i.e. about 30 torr."

In addition to using an equivalent quenching pressure of the inert gas as applicants (applicants use helium in the examples in the instant specification and Kappler et al. uses argon), Kappler et al. also uses the same electrical current (100 A) for evaporating the graphite rods and about the same collection distance (4 cm) from the vaporization source to collect the carbon particles (sooty carbon product) that inherently contain C_{60} and C_{70}. Applicants use ¼ in. (6.35 mm) diameter rods that are 1 cm in length. The volume of a cylinder is $\pi r^2 h$. Although the volume of the rod used by Kappler et al. is about half that of applicants, macroscopic amounts of C_{60} and C_{70} would be inherently produced by the method disclosed by Kappler et al. since the

lower limit that can be seen with the naked eye is 0.1 mg (see remarks filed by applicants on May 9, 2006 in instant product application where applicants state on page 28 that according to paragraph 17 of the Declaration of Dr. Raouf O. Loutfy (dated July 16, 2002 and filed in parent application 07/580,246, now U.S. Patent No. 7,494,638), 0.1 milligram or 100 micrograms is a macroscopic amount of C_{60} and C_{70} that can still be seen with the naked eye). The method of Kappler et al. inherently produces more than 0.1 mg of C_{60}/C_{70} since applicants' method produces more than 0.2 mg of C_{60}/C_{70} according to the declarations filed by applicants on September 2007 in the instant application.

As further evidence that the method disclosed by Kappler et al. inherently produces C_{60} and C_{70}, Smalley et al. discloses that fullerene (C_{60} and C_{70} being representative family members of the fullerene genus in the reference) is formed at 10 to 500 amps at 10 to 50 volts (col. 4, lines 18-21) and the pressure needed ranges from 1 to 20,000 torr, preferably 5 to 2000 torr and preferably 50 to 500 torr of helium (col. 5, lines 3-8). As shown in Table 1 of the Smalley reference, lower pressures of argon are used compared to helium to generate fullerenes (as represented by C_{60} and C_{70}). At 25 torr of Ar, the amount of fullerene (as represented by C_{60} and C_{70}) yield is 5.2 wt% of the soot (col. 10, lines 58-65).

It is noted that Dr. Harold Kroto in his declaration dated 9 June 1995 and filed on December 6, 1996 in instant product application addressed the Kappler et al. reference by stating that he did not believe that the method produced C_{60}. However, Dr. Kroto did not give any scientific explanation as to why C_{60} or C_{70} would not inherently be produced by the method

disclosed by Kappler et al. Therefore, absent factual evidence, Dr. Kroto's conclusory statement regarding the Kappler et al. reference is not persuasive.

It is noted that Smalley and Kratschmer et al. are cited as evidentiary references and not as prior art. See MPEP 2124 for exception to the rule that the critical reference date must precede the filing date.

14. Claims 128, 129 and 132 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over J. Lefevre, "Investigation of Iron and Carbon Dusts," Annales D'Astrophysique, Vol. 30, No. 4, pp. 731-738, 1967, as evidenced by Liu et al., "Experimental Results on High Yield C_{70} Fullerene," Chin. Phys. Lett., Vol. 11, No. 10 (1994), pp. 609-610, Smalley (US Patent No. 5,227,038), and Rietmeijer et al. "C_{60} and Giant Fullerenes in Soot Condensed in Vapors with Variable C/H_2 Ratio", Fullerenes, Nanotubes, and Carbon Nanostructures, Vol. 12, No. 3, pp. 659-680, 2004.

The courts have sanctioned the use of a 35 U.S.C. 102/103 rejection when the reference inherently, but not expressly, discloses a claim limitation. See MPEP §§ 2112- 2112.02.

Claims 128, 129 and 132 do not require purified cage molecules consisting of carbon atoms soluble in non-polar organic solvents.

Lefevre discloses producing carbon dusts by having an electric arc discharge in argon (p. 2 of translation). The method of producing the carbon dusts comprised of using a stable electric arc between two carbon electrodes in a twenty-liter container (see pp. 2-3 of translation). The container is first evacuated and then filled with argon (an inert quenching gas) at atmospheric pressure (1 atmosphere) and then emptied and filled again with argon at atmospheric pressure (1 atmosphere), see pages 13-14 of translation. The electric arc vaporizes the carbon electrodes and then condensation takes place to form the carbon dusts (p. 14 of translation). The arc is stabilized by a 3 kW rheostat corresponding to an intensity of 15 A under a potential difference of 20 V (see p. 4 of translation). The dusts produced are collected for examination on standard electron microscope grids at varying distances from 10 to 15 cm from the arc (p. 3 of translation). Lefevre's disclosed method for producing carbon dusts (which is a solid or a free-flowing particulate) inherently produces macroscopic amounts of C_{60} and C_{70} as evidenced by applicants' specification, Liu, Smalley and Rietmeijer et al. for the reasons given below. The two species, C_{60} and C_{70}, read on the genus "cage molecules consisting of carbon atoms soluble in non-polar organic solvents" recited in the claims.

Applicants state on page 4 of the instant specification:

> "In the production of C_{60} and C_{70}, any procedure for vaporizing carbon can be used, although the preferred method relies on the use of a high intensity electrical current with graphite rods as electrodes...The rods can be prepared using any of the various forms of carbon, such as graphite, amorphous and glassy carbon.
>
> The inert quenching gas can be any of the usual inert gases such as the noble gas. Argon and helium are preferred, the latter being most preferred…The amount of C_{60} and C_{70} produced from this carbon source is dependent upon the pressure of the quenching gas. At lower pressures relatively pure C_{60} molecules can be produced in high yield with minor concentrations of C_{70}. For the production of predominantly C_{60} molecules, the pressure at which the quenching gas is maintained should be subatmospheric and preferably about 50-400 torr. Especially

> preferred is a pressure of approximately 100 torr. The use of any lower pressure may result in reduced yield of C_{60}.
>
> However, as the pressure is raised, the ratio of C_{70}:C_{60} is also increased. If the pressure is increased to at least two atmospheres, the greatest percentage of C_{70} product is formed."

While applicants disclose the optimum range for producing C_{60} is less than 1 atmosphere, applicants disclose that if the pressure is increased to at least two atmospheres, C_{70} would be the dominant product but C_{60} would also be present. It is noted that Dr. Adam Darwish in his September 2007 Declaration filed in the instant product application stated that macroscopic amounts of C_{60} and C_{70} were produced at 2 atmosphere of the inert gas pressure. Thus, at 1 atmosphere of argon used by Lefevre, it is expected that macroscopic amounts of C_{60} and C_{70} would be inherently present in the carbon soot produced by Lefevre.

Smalley et al. discloses that fullerene (C_{60} and C_{70} being representative family members of the fullerene genus in the reference) is formed at 10 to 500 amps at 10 to 50 volts (col. 4, lines 18-21) and the pressure needed ranges from 1 to 20,000 torr, preferably 5 to 2000 torr and preferably 50 to 500 torr of helium (col. 5, lines 3-8). As shown in Table 1 of the Smalley reference, lower pressures of argon are used compared to helium to generate fullerenes (as represented by C_{60} and C_{70}). Thus, Smalley provides evidence that C_{60} and C_{70} (as represented by C_{60} and C_{70}) are formed when the electrical current is at 15 A and the pressure of the inert gas in the reactor is 1 atmosphere in the method disclosed by Lefevre.

Furthermore, Liu et al. discloses producing C_{60} and C_{70} using an electric arc discharge between two electrodes at an electric current of 35-45 A and at an inert gas pressure of 158 torr

(21000 Pa), see p. 609. Liu et al. discloses that their method produces a large amount of C_{70} for manufacturing optical devices and carrying out other research work (last paragraph on p. 610).

Rietmeijer et al. discloses producing carbon particles containing C_{60} using an electric arc discharge between two amorphous carbon electrodes at electrical current of 10 A (p. 661) and in an atmosphere of 7 torr (10 mbar) of argon (p. 661). In sample 1, the vaporization of the carbon was conducted in 100% argon without any hydrogen present and the collector surface was located 5 cm from the source (p. 662). C_{60} was found in sample 1, but C_{70} was not found in sample 1 (p. 670). The absence of C_{70} is most likely due to the low pressure of argon (7 torr).

Therefore, as evidenced by Smalley, Liu et al., and Rietmeijer et al., C_{60} and C_{70} can be produced at a wide range of current values below 100 A and are expected to be produced at a current of 15 A in the method disclosed by Lefevre.

It is noted that Smalley, Liu et al., and Rietmeijer et al. are cited as evidentiary references and not as prior art. See MPEP 2124 for exception to the rule that the critical reference date must precede the filing date.

Conclusion

15. Applicants' amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicants are reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications should be directed to examiner Dah-Wei Yuan whose telephone number is (571) 272-1295. The examiner can normally be reached on Monday through Friday from 9:00 AM to 6:00 PM.

The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

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/Dah-Wei D. Yuan/
Supervisory Patent Examiner, Art Unit 1795